Dosimetry in Fluoroscopy and Other X-Ray Procedures Requiring the Use of Protective Aprons

Policy	Rationale	Procedure
Individuals whose duties require the routine wearing of a protective apron *should* be provided with two radiation dosimeters. One dosimeter is used to monitor the dose to the whole body and should normally be worn on the chest or abdomen under the lead apron. A second dosimeter is used to monitor the exposure to the lens of the eye and should be worn at the collar outside of the lead apron.	Individuals whose duties require the routine wearing of a protective apron are exposed to significant, non-uniform radiation fields and doses. When using a lead apron, one dosimeter cannot monitor the doses received both by the protected trunk of the body and by the unprotected head and neck area. The use of two dosimeters provides a more accurate estimation of effective dose. The use of two dosimeters can help provide both the regulating radiation safety agency and the facility's radiation protection supervisor with important evidence that required protective aprons are being worn. Also, costs of providing dual dosimetry are low.	Facilities that provide two dosimeters are in compliance with the Radiation Safety Section's recommendation.
Individuals who perform or assist in fluoroscopic special procedures *shall* be provided with both a whole body dosimeter and a dosimeter to monitor the lens of the eye. Fluoroscopic special procedures include cardiac catheterization procedures and other interventional procedures.	It has been our experience, based on reviews of personnel dosimeter records and reported excessive dose incidents, recorded exposures are very likely to exceed 25 % of the limit for dose to the lens of the eye (300 millirem) in fluoroscopic special procedures. Therefore we will automatically require two dosimeters for those who perform or assist in fluoroscopic special procedures.	Facilities performing fluoroscopic special procedures that do not provide two dosimeters as addressed in this policy will be cited for rule 348(5) and any other applicable rules. Both whole body and collar dosimeters will be required. This citation will only be for the department/area of the facility that is doing the special procedures. For instance, a hospital's cardiac department would need two dosimeters but they may only need one dosimeter in their radiology department.
Declared pregnant women whose duties require the routine wearing of a protective apron *shall* be provided with both a whole body dosimeter and a collar dosimeter to monitor the lens of the eye.	For pregnant women, the dose to the fetus is limited to 500 millirem during the gestation period by rule 205. NCRP Report No. 91, *Recommendations on Limits for Exposure to Ionizing Radiation*, further states dose to the fetus shall be no greater than 50 millirem in any month. A dosimeter worn under the lead apron will provide a more accurate measure of the exposure to the abdomen, even though it probably overestimates the dose to the fetus. Therefore, we will require two dosimeters for declared pregnant women involved in fluoroscopy or other radiographic procedures requiring the use of a lead apron.	A facility with a declared pregnant woman who has not been provided with two dosimeters as addressed in this policy, will be cited for rule 348(5) for fluoroscopy or rule 353(2) for radiographic, along with a citation for rule 222.

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A facility that performs a test for the necessity of a permanently assigned auxiliary dosimeter and can demonstrate recorded doses are less than 25% of the limit may assign individuals only one dosimeter worn at the collar outside of the lead apron.	If exposures to the collar dosimeter are maintained below 25% of the limit (300 millirem), as stipulated in rule 222, we can accept the use of a single dosimeter worn at the collar to represent the dose to the whole body. Rule 203(5) states that "dose to the whole body" includes the dose to the lens of the eyes, which is what a collar dosimeter would record. We know that the dose to the trunk of the body beneath the lead apron will be lower than the dose recorded by the collar dosimeter. NCRP Report No. 57 states the exposure to the collar dosimeter will exceed the exposure under the apron by factors between 6 and 25. A single collar dosimeter will not allow as accurate an estimate of effective dose as two dosimeters but the doses will be relatively low (less than 25% of the limit) and may not require the accuracy. The dose recorded on the collar dosimeter will overestimate the effective dose.	Facilities that are not performing fluoroscopic special procedures and elect to use only one dosimeter will be informed of the Section's recommendation to switch to a two-dosimeter system for the following reasons: a. Recorded exposure from one dosimeter worn at the collar will overestimate the effective dose to the individual. This could lead to increased liability to the employer for their employee's radiation dose. b. Using two dosimeters will more accurately characterize effective dose by recording exposure to both the trunk of the body and the lens of the eye. c. Two dosimeters can help provide important evidence that required protective aprons are being worn. d. Costs of providing two dosimeters are low. Facilities that are not persuaded by our recommendation may perform a 13-week test to determine the need for a permanently assigned auxiliary dosimeter, as describe in rule 222. If at the end of the 13 week test period recorded doses do not exceed 25% of the limit (300 millirem), the facility may use one dosimeter worn outside of the lead apron at the collar. Guidance for the 13-week test: a. Facilities who have been using two dosimeters and decide to switch to one dosimeter can review their current dosimetry records for the most recent 13-week period. If exposures for the collar dosimeter have not exceeded 300 millirems during that period, the facility may switch to a one-dosimeter system. b. New facilities shall use both a whole body dosimeter worn under the apron and a collar dosimeter worn outside of the apron for at least

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		13 weeks. The results of the initial period can be used to determine if they exceed 25% of the limit. c. If a small number of users exceed 25% of the limit while most do not, those that exceed by 25% or more shall be provided with two dosimeters. d. In facilities where testing shows that the collar dosimeter clearly does not exceed 25% of the limit, new staff do not have to undergo a separate 13-week test. In those facilities where it is not as clear that everyone will be below 25% of the limit, each new staff individual shall go through the 13 week test. e. Facilities that use the one dosimeter system *should* retest every three years.
Individuals working with extremity fluoroscopes (mini C-arms) and veterinary non-fluoroscopic radiographic equipment may use only one dosimeter worn at the collar outside of the lead apron. In this case, a test for the necessity of an auxiliary dosimeter is not required. Only the operator of the mini c-arm is required to have a dosimeter. Other people that may need to be in the room are still required to wear a lead apron but are not required to have a dosimeter.	The scatter level from extremity fluoroscopes is very low and a single dosimeter is adequate. Our experience with extremity fluoroscopes is convincing enough to know that exposures from these units will not exceed 25% of the limit; therefore one dosimeter can be used without the need for testing. In fact, the levels are so low that staff assisting but not operating the unit will not be required to have a dosimeter. Veterinary radiographic x-ray machines usually have low workloads and would very seldom show exposures above 25% of the limit.	Facilities with extremity fluoroscopes (mini C-arms) and veterinary non-fluoroscopic radiographic equipment that do not have at least one dosimeter will be cited for not providing personnel monitoring.